Product Development Lead (PDL) Training Program

Combined Resources Forum
8/28/12

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Workshop Goal and Learning Objectives

- *Goal:*
  - To provide PDLs with an overview of the fundamentals of cost with attention to staying in the cost box, cost estimation and tracking, communicating cost information and impacts. Presented with an emphasis on real life experiences, lessons learned, and relevant tools.
  - To make learning Cost interesting and lively.

- *Learning Objectives*:
  - The PDLs will gain insight into cost estimation, basis of estimates, tracking, and reporting of costs.
  - The PDLs will know how to communicate cost to the Project and Management.
  - The PDLs will be introduced to the basics of cost management such as Earned Value Management (EVM).

Workshop Modules

- Module 1: NASA Federal Budget Process
- Module 2: PI and Project Scientist Role Introduction
- Module 3: Top 10 Things a Project Wants a PDL to Know
- Module 3: Top 10 Things That Cause Cost Overruns
- Module 4: Lifecycle Cost Estimating
- Module 5: Doing Procurements
- Module 5: Grassroots Costing
- Module 5: CTR and NASA Form 533
- Module 5: Statement of Work Walkthrough
- Module 5: Independent Government Estimate Walkthrough

Cost Growth

By its very definition, cost growth is a *relative measure* comparing an initial estimate of mission costs against actually incurred costs at a later time.

Source: The National Academies Press
Controlling Cost Growth of NASA Earth and Space Science Missions **(2010)**

The National Academies Press – 2010

Committee on Cost Growth in NASA Earth and Space Science Missions

Space Studies Board

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CAUSES OF COST GROWTH

Finding. ***Causes of Cost Growth.*** Past studies identify a wide range of factors that contribute to cost and schedule growth of NASA Earth and space science missions. The most commonly identified factors are as follows:

- Overly optimistic and unrealistic initial cost estimates,
- Project instability and funding issues,
- Problems with development of instruments and other spacecraft technology, and
- Launch service issues.

In addition, any problem that causes schedule growth contributes to and magnifies total mission cost growth, and cost growth in one mission may induce organizational replanning that delays other missions in earlier stages of implementation, further amplifying overall cost growth. Effective implementation of a comprehensive, integrated cost containment strategy, as recommended herein, is the best way to address this problem.

Cost Realism

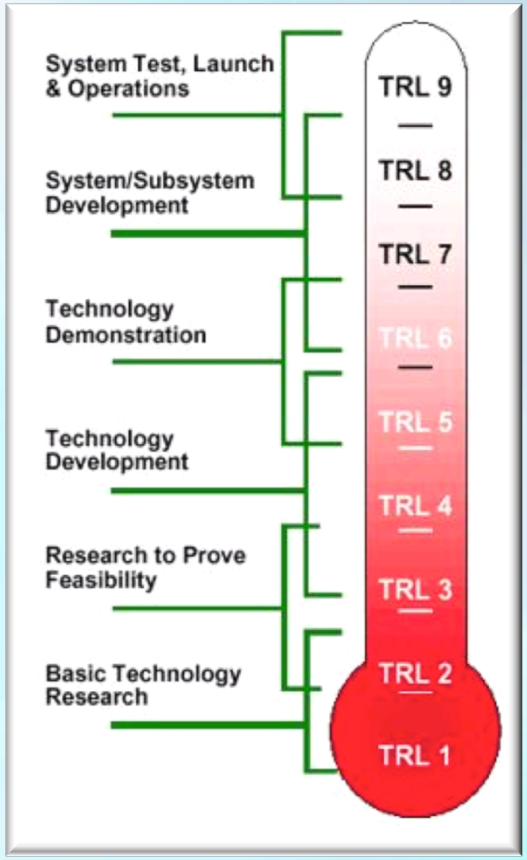
- **Cost Estimates Finding: *Unrealistic Initial Cost and Schedule Estimates.*** People and organizations tend to optimize their behavior based on the environment in which they operate. The current system incentivizes overly optimistic expectations regarding cost and schedule. As a result, initial cost estimates generally underestimate final costs by a sizable amount.

Source: The National Academies Press
Controlling Cost Growth of NASA Earth and Space Science Missions **(2010)**

Rank #1: Design Immaturity or Low Technology Readiness Level (TRL)

What should a PDL know about reaching TRL-6 and how does the product cost grow as a result?

- Competition drives aggressive proposals.
- Everything we build is one of a kind.
- Agree and understand what you are building.
- Make sure the TRL development/demonstration plan is well thought out and agreed to by stakeholders.
- Properly bound given what needs to be demonstrated (and no more): hardware, interfaces, environmental exposure.
- Develop clear performance requirements to demonstrate TRL-6.
- Lay out plan that is agreed to as sufficient by sponsor (HQ), GSFC management, and team.
- Ensure team demonstrating TRL is same team that developing the flight build.
- Fully cost the TRL development/demonstration plan, independently verify appropriateness, secure adequate funding, provide some contingency.
- Identify key milestones and track progress.



Rank #2: Requirements/Scope Creep

- Transpires when the scope of a project is not properly defined, documented, or controlled.
- Poor change control.
- Usually occurs early in the program during concept and technology development.
- It's possible that scope creep is a result of time. When there is plenty of time, new ideas can blossom and change the direction of a project.
- How to avoid?

Personal Scope Creep Example

- Power Wash and Stain deck
  - 5 Gal Stain ($100) estimated

Actual Cost –

- 10 Gal Stain ($150/ 5 gal) = $300
- Paint brushes / roller = $25
- New Gas can = $10
- New patio set = $400
- New grill = $250

TOTAL = $985…….Over run of $885

Tips on Avoiding Scope Creep

Scope control starts on day one. Every development effort should have a corresponding project plan or project agreement.

- Be sure you thoroughly understand the project vision.
- Understand your priorities and the priorities of the project drivers.
- Define and document your product plan and have it approved.
- Break the approved product plan into actual work requirements.
- Break the work down into milestones and complete a generous project schedule to be approved by management.
- Expect that there will be scope creep and perform cost-benefit analysis before implementing changes.
- COMMUNICATION!!

Rank #3: Over-Engineering

Anything can be done - if you can afford it.

- Avoidance - Identify de-scope options and acceptance of risk to avoid over-engineering.
- Develop a product that meets requirements while being sensitive to cost growth. No bells or whistles!
- Consider interdependencies and how other subsystems might be affected.
- The IM, Syst Eng, PDL and PI should continually communicate during the design/build process to ensure that minimum science requirements are met.

Rank #4: Schedule

Maintaining schedule is a key ingredient to staying inside the cost box.

Factors:

- Late requirements/design development.
- External schedule drivers (foreign partners, changing delivery dates, launch delays, contractor/vendor issues.
- Insufficient Agency/Program funding.

Resolutions:

- Work overtime? If it makes sense….yes.
- De-scope options…Can I take on the risk? If it makes sense….yes.

Remember that…

- **TIME = $$**
- Communication is key!!

Rank #5: Contractor Task Plans Higher Than the Subsystem Basis of Estimate (BOE)

The workforce plan provided by the contractor is <u>THEIR</u> estimate.

- Contractors (MSES-2A, ESES, METS) do not have access to our internal numbers and do not know what we can afford.
- The CTR (Contractor Task Report/Plan) will never exactly match what is budgeted and will likely be higher than anticipated.
- Dual responsibility of the Resources Analyst (RA) and Task Monitor (TM) to review the CTR and the contractor's SOW for accuracy, completeness and affordability.
- Avoid accepting a contractor task/CTR for the sake of getting the work started.
- Establish a communicative process between the RA, IM, PDL, CO and contractor to negotiate the level of affordability.
- The PDL needs to own the task.
- Important to remember **The task scope / value are negotiable and the CO/COTR can help facilitate conversations with the contractor

NOTE: In some cases the CTR is provided by the prime with subcontractor rates/costs that are not clearly visible. These details can be retrieved by the government Contractor Officer (CO). Examples of these in-house contract vehicles are ESES, MSES2A, METS, SES. The mechanism for initiating a task through one of these contracts is the Task Order Management System (TOMS).

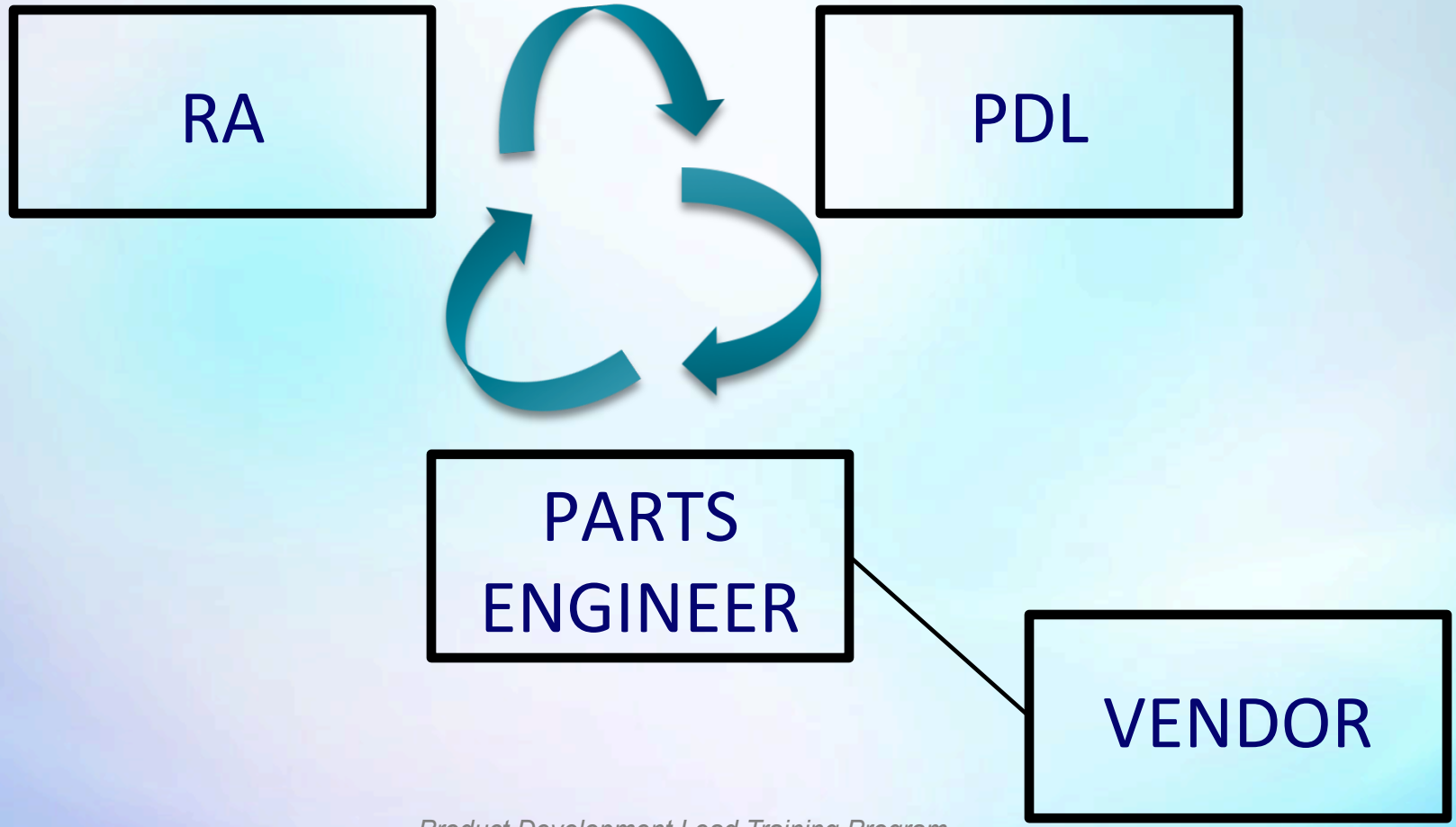
Rank #6: Hardware/Parts Costs

As a project develops, the design matures and the actual parts lists might grow or be greatly different than originally planned.

- Reasons for parts cost growth:
  - Parts lists based upon an unknown design philosophy (breadboard design vs. qualification test unit).
  - Unknown quantity or spare methodology.
  - Minimum buy requirements.
  - Purchasing vehicle (TRAX, Govt. Procurement, Contractor Task).
  - Pricing volatility.
  - Availability of custom parts.
  - Fee/taxes associated with parts (handling, inspection, kitting).
  - Labor: Quality Assurance, procurement coordination, engineering parts buyer/coordinator.
  - Be mindful and wary of counterfeit parts.

Hardware/Parts Communication

The relationships with purchasing hardware



Rank #7: Integration and Test Expenses

Following CDR, cost and schedule growth predictably occurs with late delivery of instruments and hardware and software integration and testing.

Noteworthy reasons for I&T cost overruns:

- Unidentified system engineering and integration responsibilities causing gaps and overlaps.
- Unclear responsibility for system integration.
- Integration and testing anomalies (possibly causing schedule delays).

Good practices:

- Build in adequate cost and schedule for Integration and Test (I&T) requirements.
- Know early and up front what kind and how many tests will be performed at the subsystem, instrument and spacecraft levels.

Rank #8: Workforce Competencies

Identifying and hiring the core competencies needed to deliver specific and unique production techniques is very important.

- Missing competencies will cause a subsystem to fall behind schedule or leave out vital steps in the engineering process.
- Over qualified individuals lead to unnecessary cost growth.
- Aggressive hiring strategies places a project at risk.

Rank #9: Managing the Workforce

Effectively managing a projects workforce will help prevent unnecessary cost overruns.

- Review your monthly 533's and compare against your BOE.
- Update contractor workforce task plans as required by creating task modifications in the TOMS system.
- Close contractor tasks when work is complete
- Continually track, update and advise your resources analyst on name changes within your subsystem. Note: This primarily refers to the civil servant workforce since contractor information is difficult to retrieve.
- Review the monthly civil servant workforce data provided by the resources analyst to identify anomalies, or folks that are "camping" on your WBS, or charging more hours than planned.

Rank #10: Taxes/Lab Fees

There are several taxes and lab fees that are not always known or accounted for in the initial grassroots costing exercise. Although this may not be a large driver to cost overruns, it does contribute to the equation.

Types of taxes/fees:

- Division taxes and lab fees The lab tax structure is different by organization. It's important to understand the tax structure of your own organization.
- Tier-3 Logistics – The Center logistics contractor (currently TRAX), charges labor fees associated with procuring, handling, inspecting and kitting project parts. This is often left out of the estimating process and the labor charges usually shows up well after the parts are received. A safe estimate for this labor is 10% of the parts costs.

The 501 Business Office is actively working with all AETD Divisions to gather lab fees and taxes for future proposal / budgeting exercise's

Final Thoughts

There are many reasons why cost overruns may occur on in-house instruments/projects. Most of these issues cannot be controlled by the Resources Analyst, however, the financial tools we use can provide early detection of potential issues.

Success is no longer measured by technical achievement alone, cost and schedule matter!